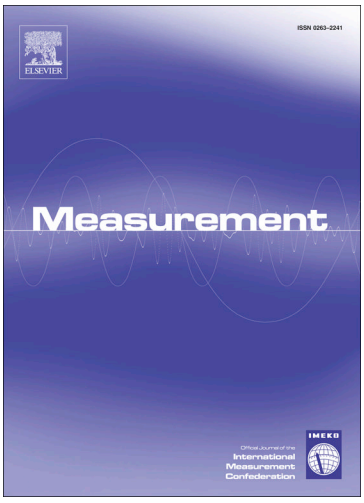

High Resistance Measurement Circuit for Fiber Materials: Application to Moisture Content Estimation

Silvia Casans, Taras Iakymchuk, Alfredo Rosado-Muñoz

PII: S0263-2241(18)30085-X
DOI: https://doi.org/10.1016/j.measurement.2018.01.072
Reference: MEASUR 5247

To appear in: *Measurement*

Received Date: 30 April 2016
Accepted Date: 31 January 2018

Please cite this article as: S. Casans, T. Iakymchuk, A. Rosado-Muñoz, High Resistance Measurement Circuit for Fiber Materials: Application to Moisture Content Estimation, *Measurement* (2018), doi: https://doi.org/10.1016/j.measurement.2018.01.072

High Resistance Measurement Circuit for Fiber Materials: Application to Moisture Content Estimation

Silvia Casans, Taras Iakymchuk, Alfredo Rosado-Muñoz

ETSE. Dpt. Electronic Engineering. University of Valencia.
Av. Universitat, s/n. 46100 Burjassot. Valencia. Spain.
e-mail: Silvia.Casans@uv.es

Abstract

Measuring very high resistance values is a difficult task since low voltage or currents are present and thus, noise and amplification must be carefully done, especially when low resistance values are required to be measured using the same circuit, too. This work proposes a novel and accurate measurement instrument for a wide range of resistance values oriented to portable applications, i.e. low power and low supply voltage (5 V) for battery operated equipment, with a small circuit design including analog sensing, digital interface (data reading and control) using a microcontroller and external communication. The proposed circuit includes an inverter attenuator with layout and configuration specially designed to allow accurate measurements and low noise contribution. An analog circuit is proposed to avoid current leakage and a allow a wide range of resistance values, a theoretical analysis of noise and other error sources is done. Experimental results show that the circuit provides accuracy and stability in the range from 1 $M\Omega$ to 100 $G\Omega$ comparable to high precision instruments requiring high voltage and long measurement time: accuracy lower than 1%. A graphical user interface was also developed to communicate with the on-board microcontroller and control/monitor all data from the circuit. Finally, as the circuit is intended to be used for resistance measurement in fiber materials where Moisture Content (MC) is directly related to the electrical resistance in the material, different wood types are analyzed over 34 days. The evolution of measured resistance in wood is seen to be related to the ambient humidity an thus, the material MC can be directly extracted. At a low cost, small circuit size and low power, the proposed circuit exceeds standards for MC estimation in timber construction materials as EN14081-1:2011.

Preprint submitted to Measurement *November 7, 2017*